



West Virginia University
College of Engineering and Mineral Resources

WVU Noise Research-2009

NIOSH funded study (1 R01 OH008723)
Real Time Hearing Protector Insertion Loss

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Principal Investigator
Professor and IH Program Coordinator



Studies in Progress



- 1) Effects of clamp force on the effectiveness of cap-mount ear muffs:
John Lewin, MS student
- 2) Fit-test results for ear muffs currently used by selected coal miners:
Alexa Quinn, MS student
- 3) Comparison of several fit-testing protocols to actual effectiveness for coal miners in mines.
Mingyu Wu, PhD student
- 4) A flashing-light intervention to improve use of HPD:
John Frazer, PhD student
- 5) Exposure feedback as a means to improve NR during work:
Brandon Takacs, PhD student & clinical faculty, WVU Ext. Service

Method: (MIRE)

- Microphone on shoulder
- Earplugs: pass tubes or microphones all the way through.
- Muffs: microphone inside.
- $NR = SPL_{\text{shoulder}} - NR_{\text{ear}}$



Custom Written Labview Data Acquisition Software

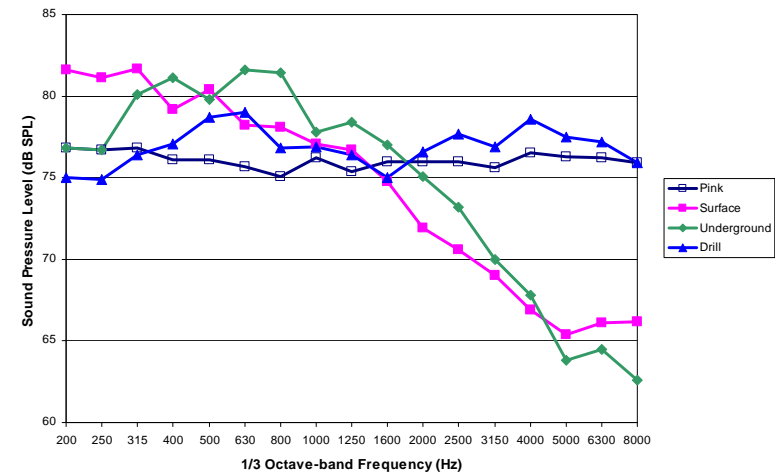


Fit Tests

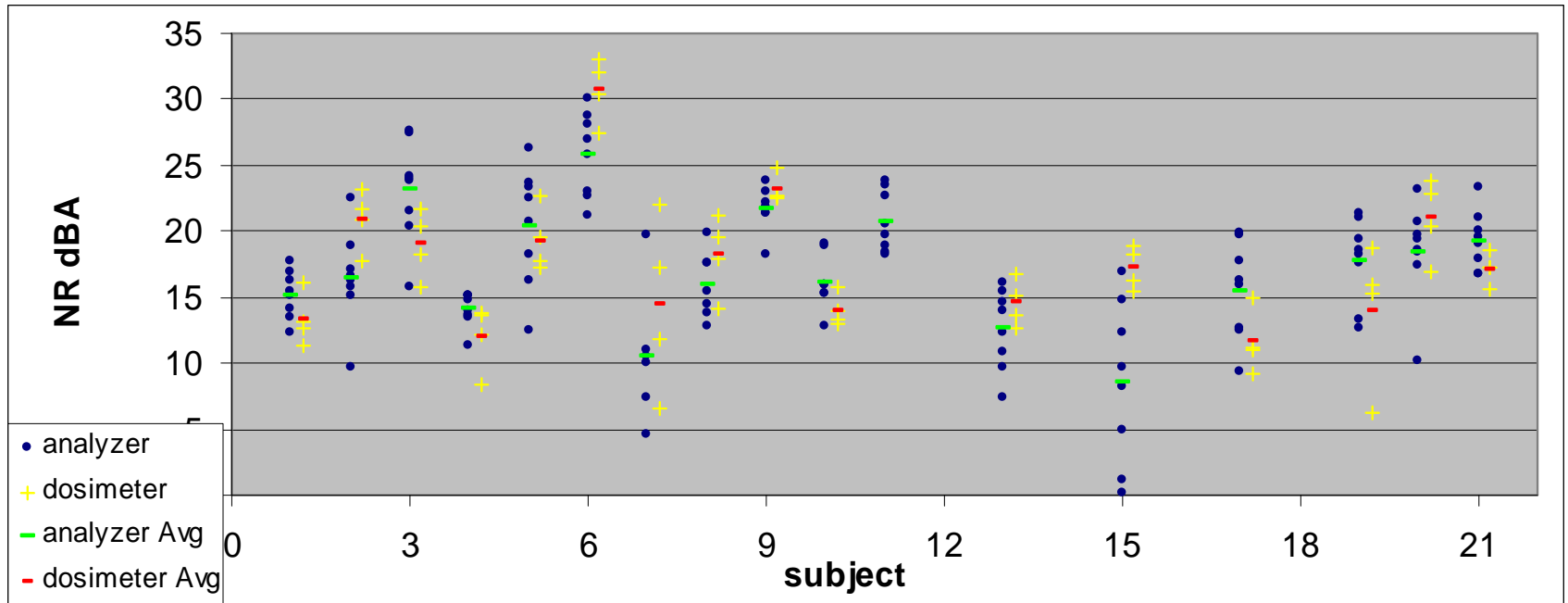
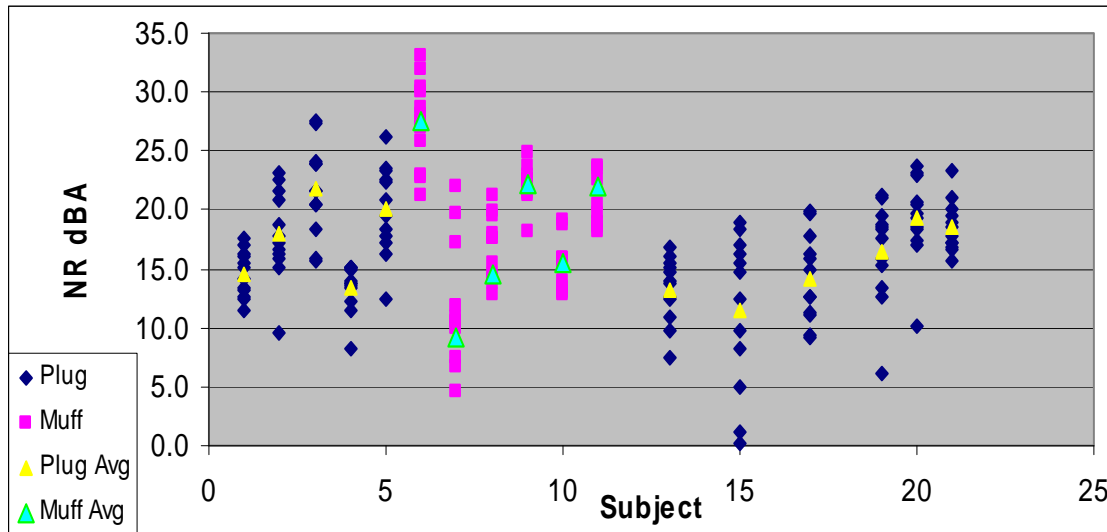
- Apparatus
 - National Instrument analyzer
 - Larson-Davis dosimeters
 - Noise Source: speaker, amplifier, equalizer
- Variables
 - Subjects
 - Analyzer vs dosimeters
 - Plugs, cap-mount muffs
 - Orientation to speaker
 - Pink noise versus simulated mine noise



Figure 1 - Spectra Types (Diffuse Field)

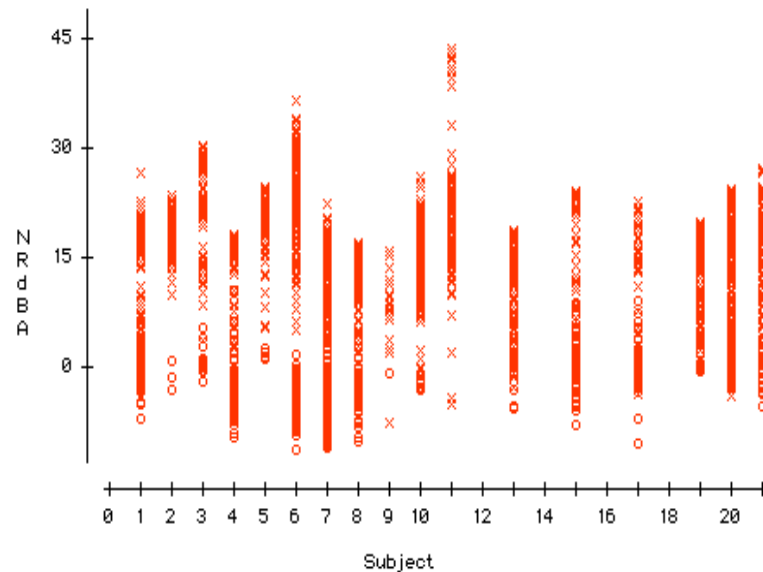
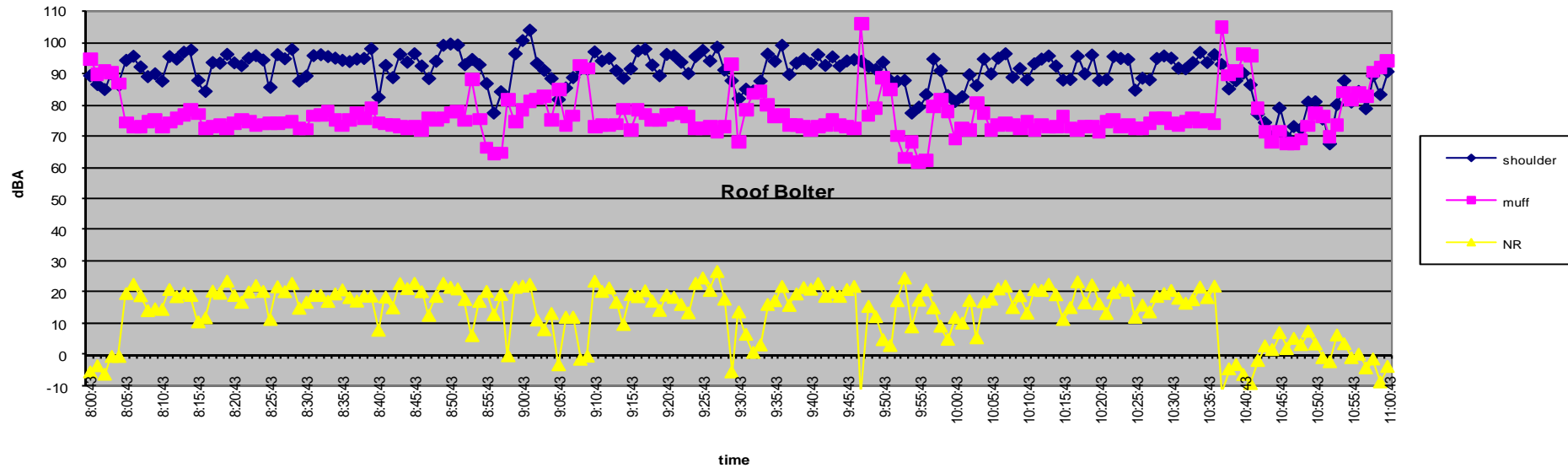


Fit-Test Results, Muffs and Plugs



NR During Coal Mining

$$NR = SPL_{\text{shoulder}} - SPL_{\text{ear}}$$



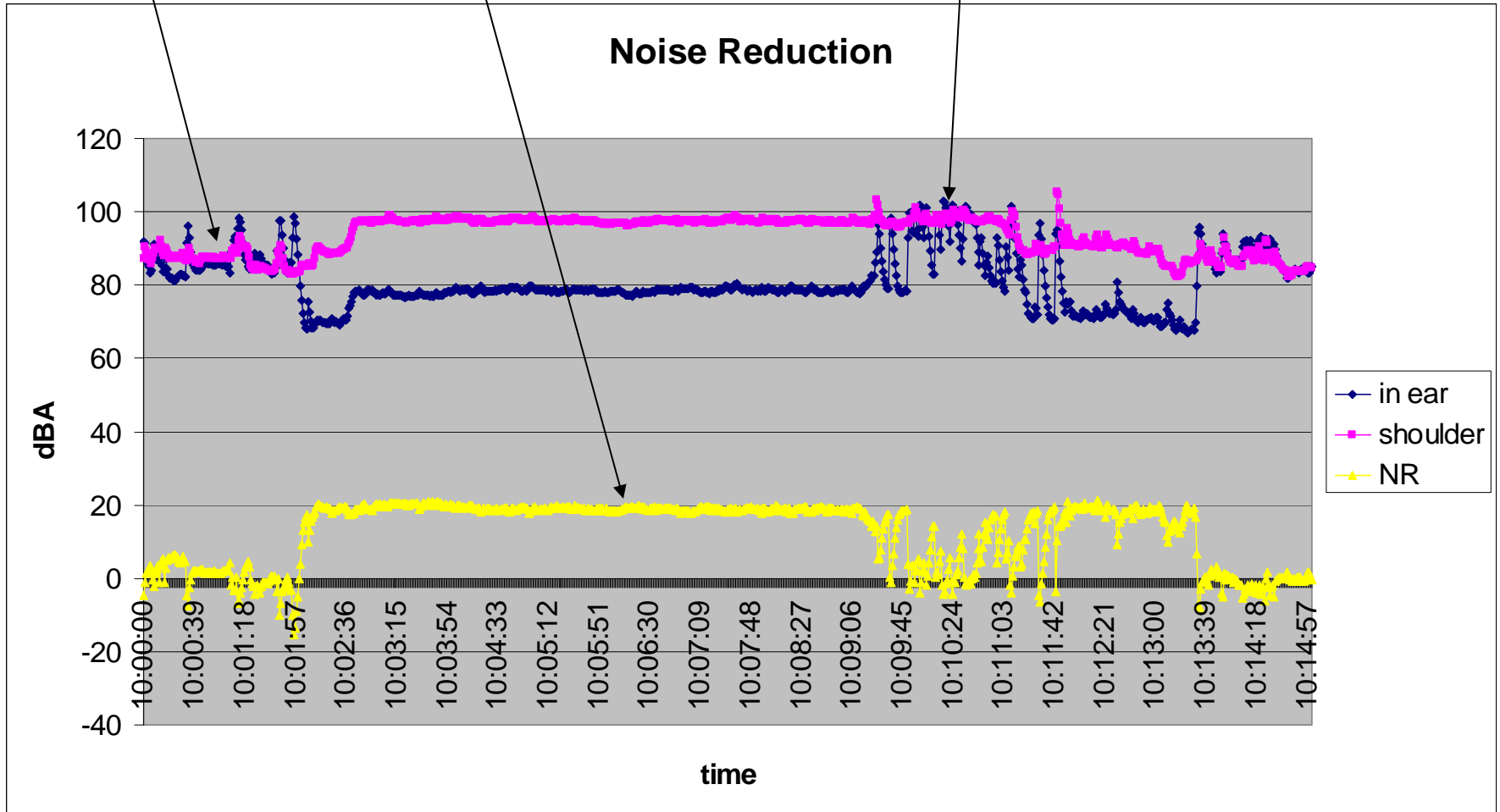
Prep Plant Operator

Not wearing HPD

Wearing HPD

Refitting HPD

Noise Reduction



* note: 3dB exchange rate, criterion 85dB



Preliminary Results - Noise

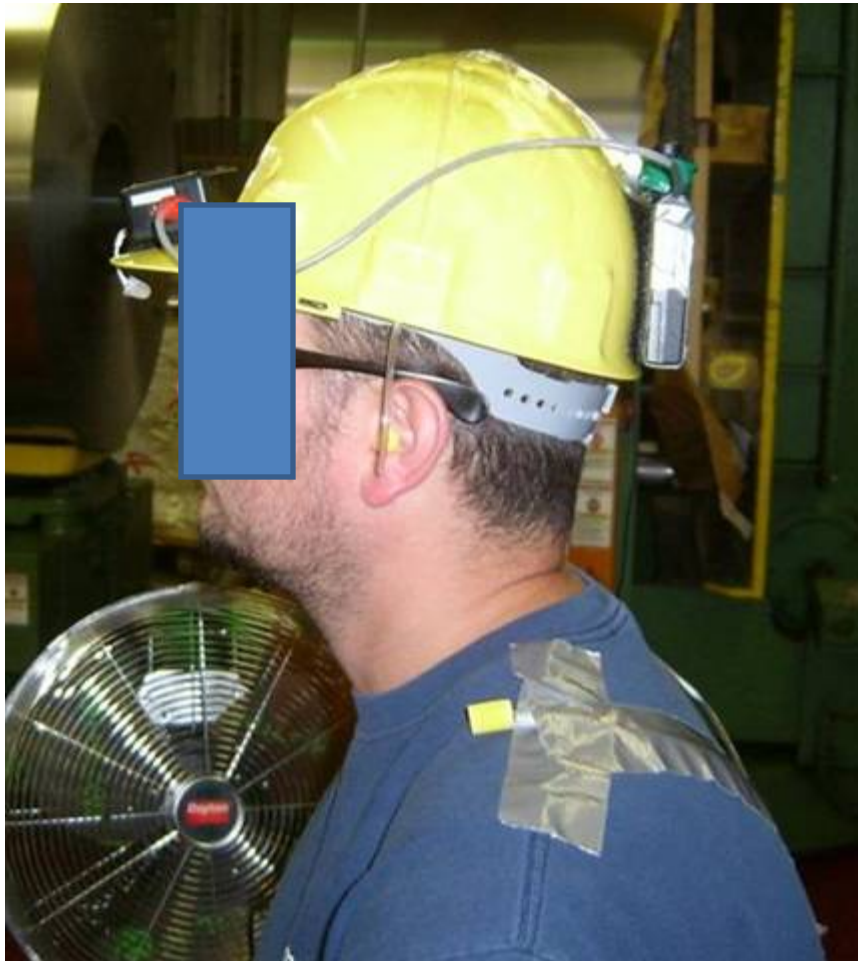
- Ear muffs and ear plugs *often* have
NR < 5 dBA
- On the job NR varied greatly minute-by-minute even when worn properly
- Fit-testing of HPD:
 - Invaluable in finding those with awful NR
 - Highly variable: should use average of many fittings



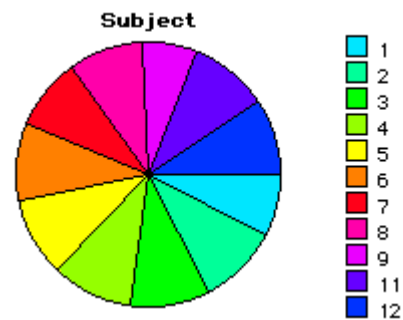
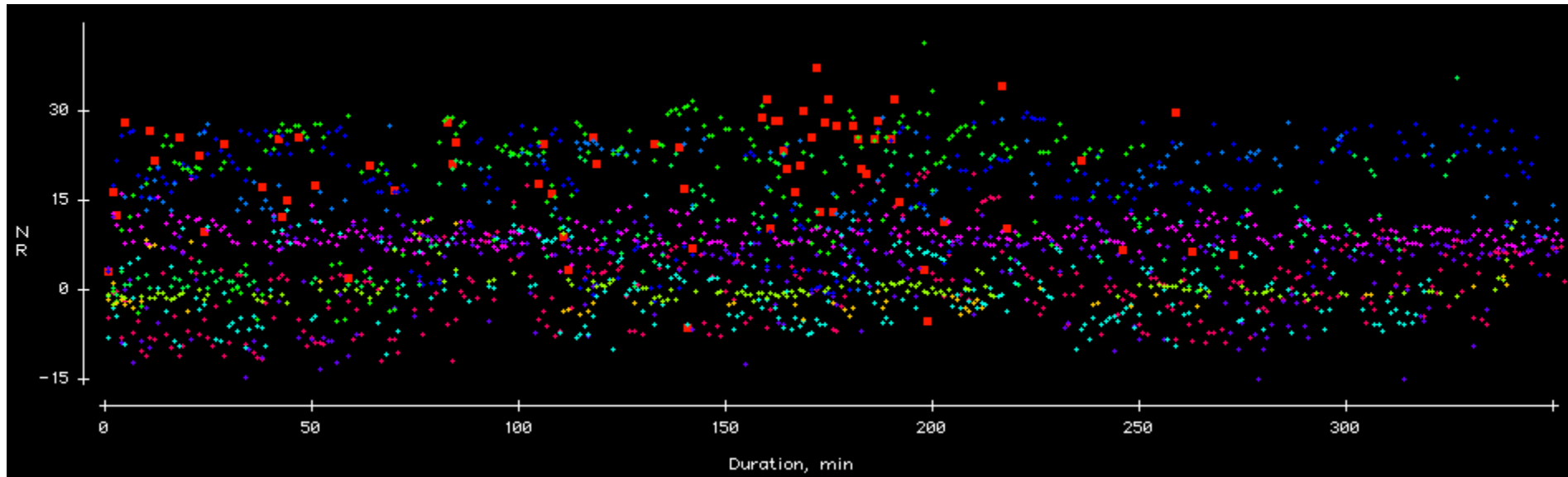
Behavior Modification by Light Signaling

Light on when noise in ear (SPL_{ear}) > 80 dBA

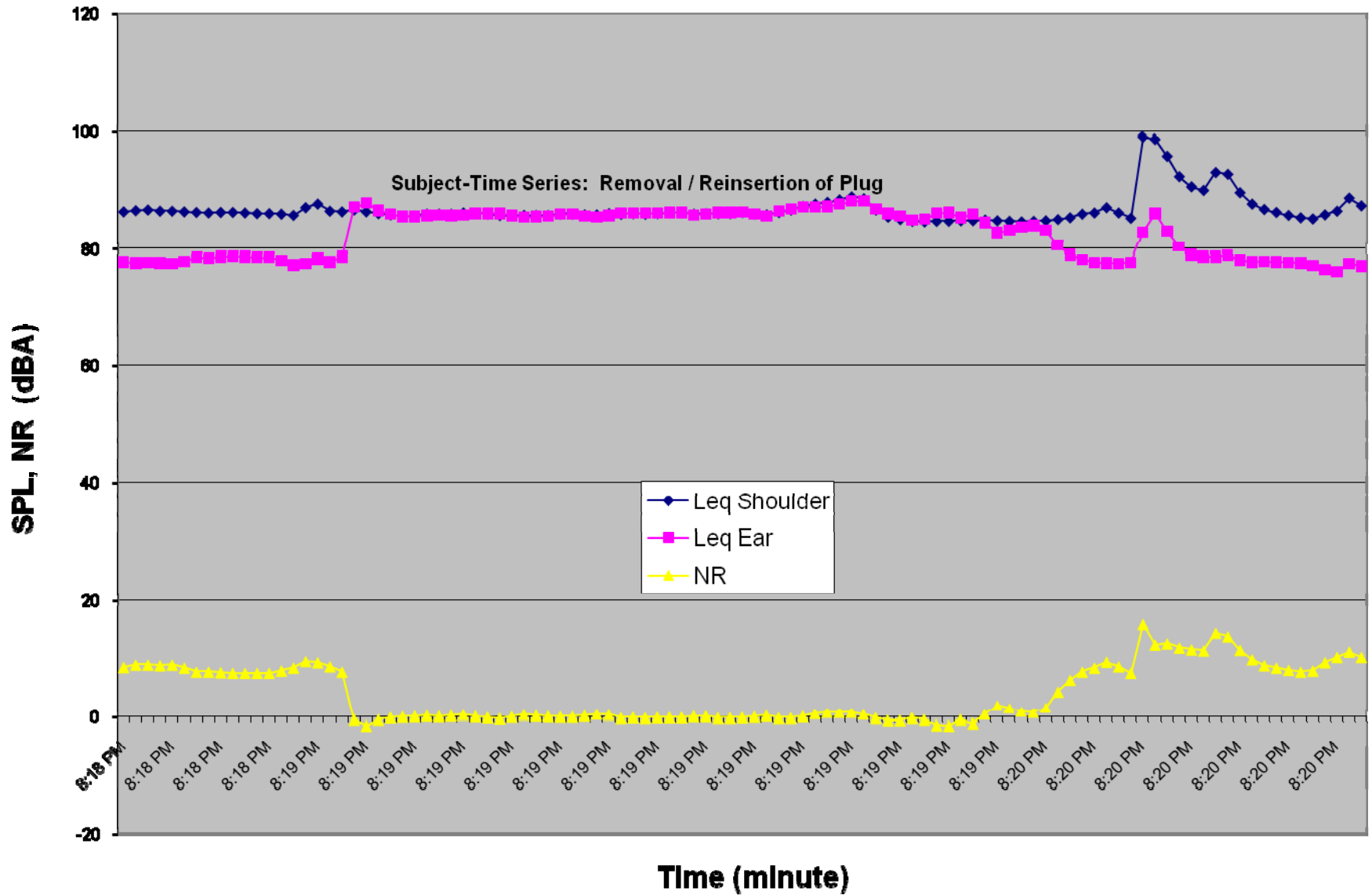
$$NR = SPL_{\text{shoulder}} - SPL_{\text{ear}}$$



All Subjects



Removal/Reinsertion of Plug



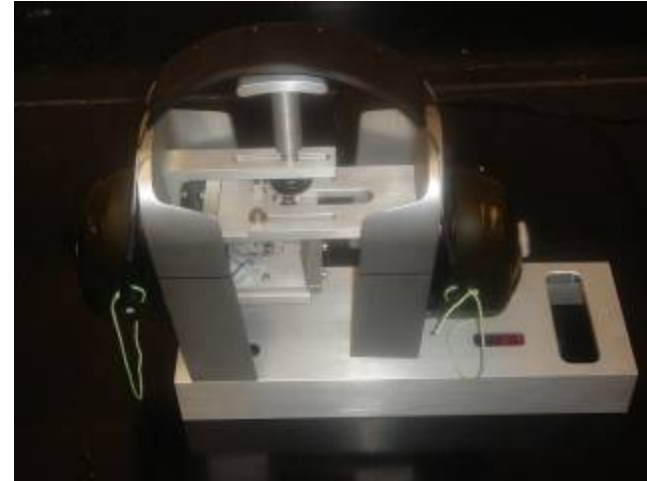
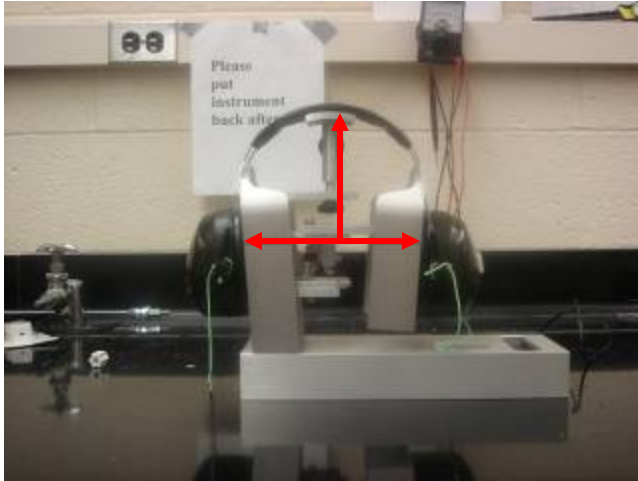
Preliminary Results –Light

- Light intervention moderately effective for those who needed reminding
 - No value if plugs didn't work (worker constantly struggled for good fit)
 - No value if already good compliance



<u>Subject</u>	<u>MeanOFF</u>	<u>MedianOFF</u>	<u>75%OFF</u>	<u>90%OFF</u>	<u>StdDevOFF</u>	<u>MeanOn</u>	<u>delNR</u>	<u>Fit</u>
1	20	22	20	28	9	19	0	Great
2	-2	-2	-2	4	5	4	6	Awful
3	9	9	9	13	2	9	0	
4	0	2	0	9	8	5	5	
5	16	18	16	26	9	20	4	
6	19	18	19	26	5	18	-1	Great
7	0	-1	0	10	6	1	0	Awful
8	8	5	7	21	8	16	8	
9	18	22	19	28	10	24	6	Great
11	0	0	0	1	1	1	2	Awful
12	-1	-2	-2	7	4	0	0	Awful

Clamp Force



- Clamp force varies based on head size
- Width / breadth & length correlated with force
- 95th percentile, facial dimensions for male and female
- Especially an issue with Cap Mount Muffs



Other Cool Research



Questions?